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1. Document ID: US 6503364 B1

L1: Entry 1 of 2

File: USPT

Jan 7, 2003

US-PAT-NO: 6503364

DOCUMENT-IDENTIFIER: US 6503364 B1

TITLE: Plasma processing apparatus

DATE-ISSUED: January 7, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Masuda; Toshio	Toride			JP
Usui; Tatehito	Nihari			JP
Shirayone; Shigeru	Ebina			JP
Takahashi; Kazue	Kudamatsu			JP
Suehiro; Mitsuru	Kudamatsu			JP

US-CL-CURRENT: 156/345.24; 118/712, 118/723MA, 118/723MR, 156/345.42, 156/345.46,  
156/345.49

ABSTRACT:

In the plasma processing apparatus for generating plasma in a processing chamber and processing a wafer by mutual action of electromagnetic waves radiated from a UHF band antenna installed in the processing chamber and a magnetic field formed by a magnetic field generator installed around the processing chamber, a hollow tube having one end in communication with an opening in the side wall of the processing chamber and another end, outside the processing chamber, which has a measuring window of plasma optical emission. By setting the lines of force of the magnetic field formed by the magnetic field generator so as to form an angle relative to the hollow tube, entry of plasma into the hollow tube can be prevented, and adhesion of deposits onto the measuring window can be suppressed, whereby the transmission factor of the measuring window can be kept constant over a long period of use.

7 Claims, 6 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 4

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	RWMC	Drawn De
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## □ 2. Document ID: US 6245190 B1

L1: Entry 2 of 2

File: USPT

Jun 12, 2001

US-PAT-NO: 6245190

DOCUMENT-IDENTIFIER: US 6245190 B1

TITLE: Plasma processing system and plasma processing method

DATE-ISSUED: June 12, 2001

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Masuda; Toshio	Toride			JP
Mitani; Katsuhiko	Hikari			JP
Kaji; Tetsunori	Tokuyama			JP
Tanaka; Jun'ichi	Chiyoda-machi			JP
Watanabe; Katsuya	Kudamatsu			JP
Shirayone; Shigeru	Kudamatsu			JP
Otsubo; Toru	Fujisawa			JP
Sasaki; Ichiro	Yokohama			JP
Fukumoto; Hideshi	Hitachinaka			JP
Koizumi; Makoto	Naka-machi			JP

US-CL-CURRENT: 156/345.46; 118/723MA, 118/723R

## ABSTRACT:

A plasma processing apparatus and a method therefor which can achieve a preferred process rate, a fine pattern process capability, a selectivity and uniformity of processing at the same time compatibly for a large size wafer, which effects are achieved by controlling the plasma state and the dissociation state of etching gas through control of the electron resonance through application of a magnetic field thereto. A high frequency power at 20-300 MHz is applied across a pair of electrodes in a vacuum process chamber, and a magnetic field is formed parallel to the plane of the electrodes in the space between the electrodes. By controlling the intensity of the magnetic field in a range of 100 gauss or smaller, formation of electron cyclotron resonance and electron sheath resonance occurring from interaction between the electrical field and the magnetic field in the electrode sheath portion is controlled. Thereby, the plasma state, i.e., the electron density, electron energy distribution and dissociation state of the process gas in the plasma, can be controlled. The magnetic field is generated by a plurality of coils, an outer shield, and pendant yoke to form magnetic field parallel to the plane of the electrodes in the space between the upper and the bottom electrodes.

10 Claims, 50 Drawing figures

Exemplary Claim Number: 5

Number of Drawing Sheets: 34

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	KOMC	Draw
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